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BUCKWHEAT MILLING AND ITS BY-PRODUCTS

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INTRODUCTION

Buckwheat (*Fagopyrum esculentum*) products have long been considered excellent foods both for human beings and for animals. The grain, therefore, has a place in agriculture with other grains, although it is a minor crop when compared with corn, oats, or wheat. For every bushel of buckwheat harvested in the United States in 1930, there were produced about 231 bushels of corn, 156 bushels of oats, 94 bushels of wheat, 36 bushels of barley, 5 bushels of rye, and nearly 4½ bushels of rice. Flour is the principal commodity derived from this black triangular fruit, but groats and farina obtained from it are also used as foods, and certain by-products are used as feed. The hulls are generally burned.

According to the records, the natural habitat of buckwheat is Asia, but in the course of time it was grown in Europe, and later it was brought to America by the Dutch colonists who settled along the Hudson River. Unlike the true cereal grains such as wheat, oats, and rye, it may be grown with abundant yields on poor, thin, acid soil where the climate is cool and moist.

As a buckwheat-producing country, the United States ranks third in the world, being surpassed only by Russia and France. Table 1 shows the buckwheat production in each of these three countries for the years 1924 to 1930, inclusive. The total production in the United States for the year 1930 was 8,975,000 bushels. This is a decrease of about 3,000,000 bushels as compared with the total production for 1929.

TABLE 1.—*Production of buckwheat in the principal buckwheat-growing countries, average 1924 to 1928, and 1929 and 1930*

Year	United States	Russia	France
	1,000 bushels	1,000 bushels	1,000 bushels
1924-1928 average.....	13, 416		
1929.....	11, 505	78, 865	17, 037
1930.....	8, 975		17, 989

Pennsylvania and New York produced more than 66 per cent of all the buckwheat grown in the United States in 1930; more than 20 per cent was produced in Minnesota, Ohio, West Virginia, Wisconsin, and Maine together.

The average exports of buckwheat from the United States during 1924-1928 amounted to 225,000 bushels, or less than 2 per cent of the crop. In 1929, the exports fell to 191,000 bushels, and in 1930 only 8,000 bushels were shipped out of the country.

For the same periods the imports of buckwheat into this country were 174,000, 160,000, and 465,000 bushels, respectively.

The legal weight for buckwheat per bushel is 48 pounds in most of the States in which it is produced, but in other States it ranges from 40 to 56 pounds. Twenty-six samples of the Sando Soba variety,

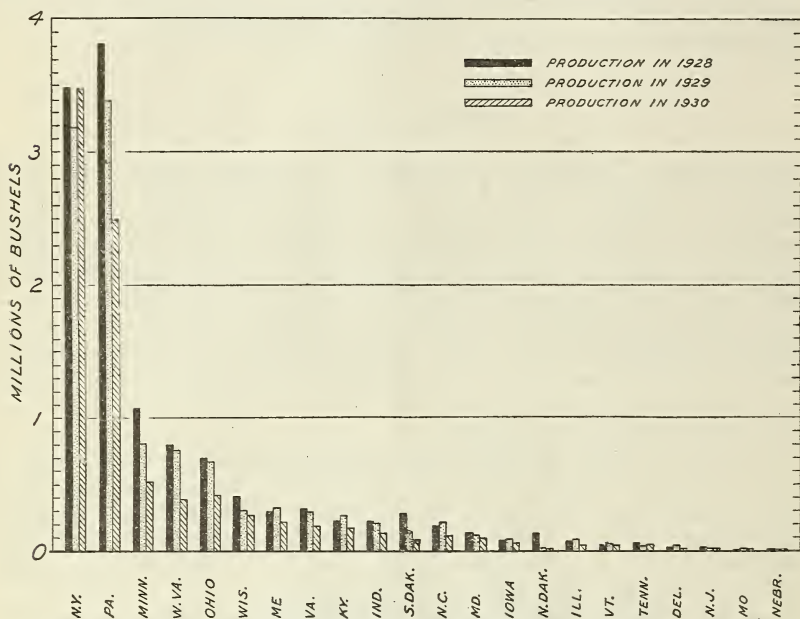


FIGURE 1.—Chart showing the buckwheat produced in 1928, 1929, and 1930, in the principal buckwheat-producing States

a Japanese buckwheat, examined in this laboratory had an average weight of 45.3 pounds per bushel. (Table 3.)

VARIETIES OF BUCKWHEAT

The two principal varieties of buckwheat grown in the United States are the Silverhull and the Japanese. (Fig. 2.) A third variety, Tartary buckwheat, known also as Indian wheat and rye buckwheat, is grown to a limited extent in the mountains of North Carolina, in Maine, in New York, and in a number of other places in the United States and Canada. In milling qualities and taste, Tartary buckwheat does not compare favorably with the common varieties. It is more often used as a feed for horses and hogs. When used as feed, the fruits are ground, and the hulls are removed. Chickens, however, eat the whole grain without ill effects.

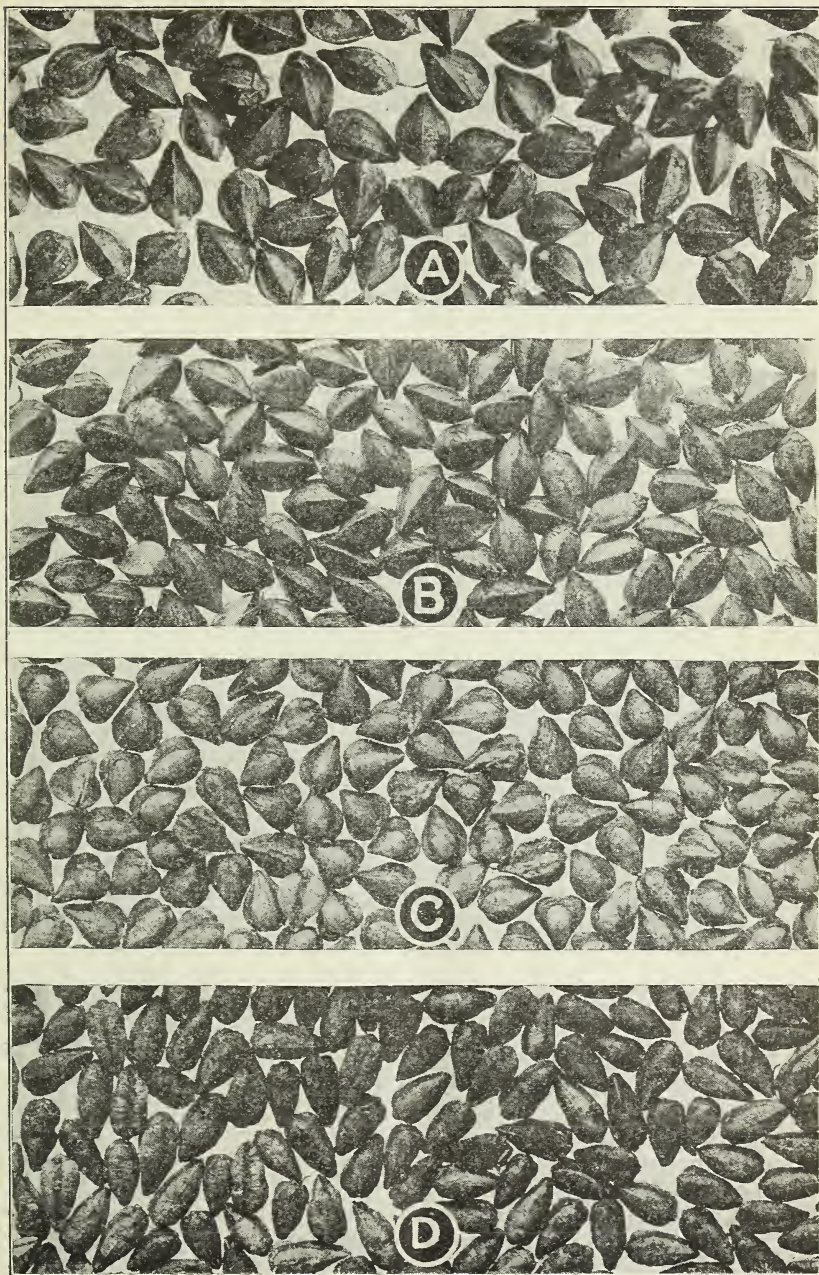


FIGURE 2.—Fruits of four varieties of buckwheat: A, Japanese; B, Silverhull; C, Mountain; D, "Rye". A and B belong to the species *Fagopyrum esculentum*; C and D to the species *tataricum*. (About double natural size)

MILLING FOR BUCKWHEAT FLOUR

Buckwheat mills are usually in the heart of the buckwheat-producing areas, where most of the grain may be delivered direct, although some of the large mills obtain grain in carload lots from other buckwheat-producing sections, sometimes as far away as Japan. The chief buckwheat milling centers in the United States are Pennsylvania, New York, Wisconsin, Maine, and Ohio.

Both the Silverhull and the Japanese buckwheat are used for making flour. The Silverhull is the more desirable as it has more endosperm and thinner hulls, and consequently it yields more flour. Laboratory analysis showed that the hull constitutes 18.4 per cent of the Silverhull and 20.5 per cent of the Japanese variety. The Japanese variety is the best for making groats, however, on account of the shape of the hull.

When the buckwheat is brought to the mill it is placed in large receiving bins. From there it is elevated to the upper floor of the building to a separator, where all sticks, vines, and other coarse foreign material are removed. The partly cleaned grain then goes to a central delivery unit on the floor below, where it is directed to sieves and separators which remove nails, wire, and pebbles.

In modern mills the grain is then dried to approximately 12 per cent moisture. This moisture content not only provides the best milling quality, but it aids materially in the next step, the removal of dust, fuzz, and the calyx adhering to the fruit. This is accomplished by means of a scouring machine, all loosened material being separated by aspirators. At the end of this treatment, the grain is clean and polished and ready to be milled.

The grain then passes through the first break rolls, which crack the hulls and loosen them from the kernel. It is again dried to 12 per cent moisture in a long revolving cylinder provided with steam pipes on the inside. Without this second drying a portion of the kernel would be left in the hull.

From the drier the grain goes to the first set of sieves, which remove the hulls and separate the flour. The material left is reduced by one, two, or more sets of rolls, each grinding operation being followed by a sifting which removes the flour from the middlings. The milling process is shown in detail in the flow sheet in Figure 3.

Some buckwheat flour is milled as fine as wheat flour. This is accomplished by bolting machines similar to those used in milling wheat.

A mill with a capacity of 1,200 barrels of flour per day averages 78 pounds of flour, 4 pounds of middlings, and 18 pounds of hulls for every 100 pounds of buckwheat ground. Another mill with a capacity of 200 barrels per day averages 62 pounds of flour, 12 pounds of middlings, and 26 pounds of hulls. Still another mill of 75 barrels per day capacity obtains 60 to 68 pounds of flour, 16 pounds of middlings, and 24 pounds of hulls. Only about 52 pounds of really white flour per 100 pounds of grain may be obtained by special milling.

People in different localities seem to prefer different kinds of buckwheat flour. The eastern trade demands a white flour which is almost entirely starch, the western trade prefers a dark flour which contains middlings and fine particles of hulls, and still others like a flour which is between the two.

Buckwheat flour is used almost exclusively for making griddle cakes. A mixture of flour, water, and a leavening agent is spread thinly on a hot griddle where cooking is completed in a few minutes. Buckwheat flour is combined with flours of other grains to make a pancake flour mixture. This preparation is sold more extensively in the United States than the pure buckwheat flour.

MILLING FOR GROATS

In milling for groats the buckwheat is prepared the same as when it is to be made into flour. It is then passed over sieves four or five times, in order to separate the grains of uniform size. The very small and the very large kernels are milled for flour. The medium-size kernels are kiln-dried to 12 per cent moisture or less and are then passed between two mill stones so adjusted that they crack the hull without grinding the groat appreciably. The product is then passed

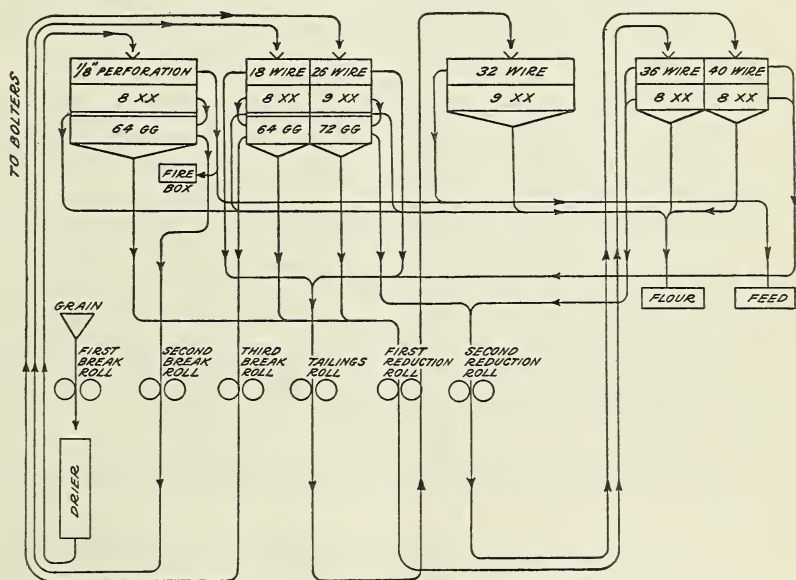


FIGURE 3.—Flow sheet for buckwheat flour manufacture. (8xx, 64gg, etc., mean different sizes of screens and cloth in sifters)

over sieves of different meshes to remove the hulls. All dust and flour are separated by means of aspirator purifiers. The groats are graded into whole groats and two or more sizes of broken groats. Very small fragments are made into flour.

From buckwheat groats two types of food are made, roasted broken kernels and farina. The latter is obtained from the starchy center. They are used as porridge and in soups by people of French, Russian, and Rumanian extraction. Sometimes they are used as breakfast foods.

BUCKWHEAT BY-PRODUCTS

The Association of American Feed Control Officials has adopted the following definition for buckwheat by-products (1)¹: "Buckwheat shorts or buckwheat middlings are that portion of the buck-

¹ *Italic numbers in parentheses refer to Literature Cited, p. 11.*

wheat grain immediately inside the hull after separation from the flour."

The most valuable by-product from the milling of buckwheat is the dirty-green oily covering of the grain lying just beneath the hull, which, together with the germ, is called middlings. They make a valuable feed for farm animals when used with other feeds, being rich in protein, mineral matter, and other nutritious substances. Leighty (4) states that buckwheat middlings fed to dairy cattle increase the flow of milk and have no injurious effects on the animals or the dairy products. In trials at the Pennsylvania Agricultural Experiment Station, Bechdel (2) found that for milk production buckwheat middlings have a feeding value equal to that of corn gluten feed.

Studies by Longwell (6) and by Robinson (8) indicate that the proteins of buckwheat middlings have a high feeding value for growing and fattening pigs, being superior to that of wheat middlings and equal to or better than that of linseed meal. When used with other protein feeds, for example, linseed meal, tankage, wheat middlings, and alfalfa meal, as a supplement to corn, rapid and economical growth resulted.

Livesay and Stillwell (5) found that buckwheat middlings produced more rapid gains in weight in swine and required less concentrates to produce 100 pounds gain than did standard wheat middlings when each was fed in conjunction with corn and tankage.

Other experiments conducted by Longwell to ascertain the vitamin potency of buckwheat middlings revealed that vitamins A and D are either absent, or present in only very small quantities. When the buckwheat middlings were fed to pigs as the only source of these vitamins, the pigs developed the typical A and D deficiency symptoms. These findings are corroborated by Shimoda and his colleagues (9). On the other hand, buckwheat is abundantly supplied with water-soluble vitamin B, according to experiments by Palladin (7) and also by Shimoda (9).

Table 2 shows the chemical composition, coefficients of digestibility, and percentage of digestible nutrients of pure buckwheat middlings (6).

TABLE 2.—*Chemical composition, coefficient of digestibility, and digestible nutrients of buckwheat middlings*

Item	Dry substance	Ash	Crude protein	Crude fiber	Nitrogen-free extract	Fat
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
Average composition.....	88.5	4.5	27.5	4.2	45.3	7.0
Coefficient of digestibility.....	80.0	-----	85.0	83.0	-----	88.0
Digestible nutrients.....	70.8	-----	23.4	37.6	-----	6.2

As the composition of buckwheat flour varies, buckwheat by-products found on the market lack uniformity. Many of the buckwheat middlings contain too large a proportion of hulls to make a satisfactory feed. Such products generally come from small mills not equipped with modern machinery. Feed of this character is usually sold to local consumers, but enough of it is sold on the general market

to warrant a less misleading name (5). The name "buckwheat feed" has been proposed for such a mixture.

Buckwheat hulls have very little feed value; they are even detrimental as feed for pigs (8). Most mills burn their hulls. Some, however, are sold as packing material for bottled goods and glass bulbs. They are also sold as bedding for animals, as they absorb the moisture from the excreta better than straw or shavings. There is one objection to their use for this purpose, however, the hulls may lodge between the digits of the animals and cause infection.

Buckwheat forage or straw is sometimes used for a dairy feed on account of its large quantity of nutrients in the form of carbohydrates and minerals (4).

The by-products of the groat-milling process consist of hulls, fine particles of endosperm, and small pieces of groats. The hulls are usually burned. The fragments of groats and endosperm are made into flour.

ANALYSES OF BUCKWHEAT

Tables 3 to 11 contain analyses of the buckwheat grain and of its various milling products. The data in Tables 4 to 10 were taken from Buckwheat and Its By-Products,² issued by the Food and Drug Administration.

² COE, M. R., and BIDWELL, G. L., BUCKWHEAT AND ITS BY-PRODUCTS. U. S. Dept. Agr., Food and Drug Admin. Inform. Sheet, 13 p. March, 1924. [Mimeographed.]

TABLE 3.—*Analyses of the Sando Soba variety of Japanese buckwheat and differences in composition as influenced by locality where grown and source of seed*¹

Laboratory No.	Year	Where grown	Source of seed	H ₂ O	Ash	Fat	Fiber	Protein	Nitrogen-free extract	Pentosans	Total sugars	Weight in grams per bushel	Weight in grams per 1,000 seeds	Hulls	P ₂ O ₅
				Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Pounds	Grams	Per cent	Per cent
6225	1909	McPherson, Kans.	McPherson, Kans.	8.11	1.96	2.61	11.17	11.25	64.90	7.34	1.43	44.8	24.9	21.3	0.80
6226	1909	Ithaca, N. Y.	do.	8.92	1.78	2.33	9.19	12.13	65.65	6.77	0.92	45.3	29.7	19.8	.52
8058	1910	Ames, Iowa	do.	10.05	3.33	2.46	9.60	13.06	61.50	5.66	1.13	46.7	29.4	18.4	.82
8059	1910	do.	Ithaca, N. Y.	9.78	2.21	2.54	9.30	13.44	62.73	5.90	0.79	45.3	29.4	21.0	.76
8060	1910	do.	do.	9.88	1.90	2.38	11.08	11.75	63.01	6.90	1.22	46.2	25.3	24.3	.62
8061	1910	Ithaca, N. Y.	do.	8.59	2.01	2.48	10.88	12.44	63.00	7.20	1.22	42.2	24.1	23.1	.63
8062	1910	Blacksburg, Va.	do.	9.67	1.73	2.51	10.36	11.44	64.29	6.54	1.14	46.7	30.0	25.8	.48
8063	1910	do.	Ithaca, N. Y.	9.34	1.77	2.44	10.58	11.25	64.62	6.23	0.97	47.5	30.0	21.1	.45
10488	1911	Ames, Iowa	Iowa	9.37	2.25	2.67	8.38	13.25	64.08	6.15	1.23	46.7	30.8	17.6	.74
10489	1911	do.	New York	9.46	2.81	2.51	8.87	12.81	63.54	6.18	1.19	46.5	29.2	18.6	.78
10490	1911	do.	Virginia	8.47	2.52	2.57	8.46	13.31	64.67	6.04	1.37	46.7	28.0	18.3	.79
10491	1911	Ithaca, N. Y.	New York	9.18	2.19	2.65	9.32	13.31	63.35	6.49	1.11	46.2	29.5	20.2	.94
10492	1911	do.	Iowa	8.46	2.21	2.46	9.18	13.81	63.88	6.34	1.03	46.7	30.7	19.4	.70
10493	1911	do.	Virginia	9.74	2.24	2.54	9.53	13.69	62.26	6.55	1.15	46.5	28.4	20.1	.73
10494	1911	Blacksburg, Va.	do.	9.66	1.61	2.46	11.01	11.38	63.88	7.09	1.34	45.8	28.3	21.7	.46
10495	1911	do.	Iowa	9.66	1.75	2.45	10.37	11.88	63.89	6.61	1.30	44.5	28.8	20.3	.49
10496	1911	do.	New York	9.71	1.75	2.59	11.24	11.94	62.77	6.73	1.27	44.5	27.5	20.6	.49
12127	1912	Ames, Iowa	Iowa	10.08	2.60	2.54	10.42	11.56	62.80	7.00	1.30	43.5	26.9	20.7	.89
12128	1912	do.	Virginia	9.90	2.40	2.54	10.83	12.19	62.14	6.81	1.35	42.6	27.2	21.1	.85
12129	1912	do.	New York	9.49	2.26	2.48	10.45	12.06	63.26	7.14	1.43	42.1	26.6	21.4	.77
12130	1912	do.	Iowa	9.36	1.88	2.07	10.00	12.13	64.56	6.94	0.88	44.8	28.3	21.5	.67
12131	1912	Ithaca, N. Y.	do.	9.53	1.92	2.35	9.00	12.50	64.75	6.46	0.90	46.2	28.6	20.6	.69
12132	1912	do.	New York	9.42	1.85	2.20	10.35	12.50	63.63	7.20	1.13	45.6	29.9	20.0	.65
12133	1912	do.	Iowa	10.10	1.81	2.23	11.00	8.63	66.23	7.10	1.26	45.3	27.1	23.7	.53
12134	1912	Blacksburg, Va.	do.	9.48	1.55	2.27	11.65	9.50	65.55	7.82	1.23	45.3	27.0	24.3	.39
12135	1912	do.	Virginia	9.92	1.63	2.35	10.30	8.94	66.86	7.50	1.20	45.3	27.1	23.2	.42
12987		do.	New York	9.20	1.78	2.56	10.68	11.75	64.03	6.77	1.18	45.3	26.6	22.2	

¹ These results have been selected from the so-called "tri-local experiments on the composition of cereals and seeds," carried on for many years by J. A. LeClerc and his associates.

TABLE 4.—*Analyses of whole buckwheat grain*

Sam- ple No.	Variety	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
45543	Japanese whole grain.....	10.05	1.71	2.36	10.69	11.37	63.82
45542a	Silverhull whole grain.....	10.01	1.81	2.43	11.81	9.92	64.02
45851a	Tartary whole grain.....	11.06	1.64	2.32	10.19	15.21	59.58

TABLE 5.—*Analyses of buckwheat groats* ¹

Sam- ple No.	Variety	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
45544	Japanese buckwheat groats.....	11.11	1.73	2.81	12.63	0.76	70.96
45542c	Silverhull buckwheat groats.....	10.19	1.92	2.88	14.13	.90	69.98
45851c	Tartary buckwheat groats.....	11.85	1.86	2.94	12.81	1.19	69.35
44446	Buckwheat groats.....	10.31	1.91	3.29	13.75	.61	70.13
44448	...do.....	10.81	.45	.79	4.47	.31	83.17

¹ The results given for the first 4 samples are for whole groats; those for the last sample are for broken groats, with the starchy portion predominant.

TABLE 6.—*Analyses of buckwheat products after each break* ¹

Sam- ple No.	Break	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
45548	First.....	9.70	1.88	2.55	11.56	9.77	64.54
45549	Second.....	9.57	2.14	2.98	13.94	6.91	64.46
45550	Third.....	8.09	3.93	5.84	24.81	13.47	43.86
45551	Fourth.....	8.31	4.71	6.98	30.13	11.48	38.39
45552	Sixth.....	8.46	3.92	6.10	26.63	11.82	43.07
45546	(?).....	8.53	4.14	5.72	24.94	17.69	38.98

¹ Samples were taken while the mill was running. Each sample represents the product just after it has gone through that particular break previous to bolting.

² Products remaining after last bolting for flour. This is used for feed.

TABLE 7.—*Analyses of buckwheat flour* ¹

Sam- ple No.	Color	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
45554	Very light.....	12.65	0.61	0.50	4.73	0.39	81.12
45558	Light.....	13.15	1.17	1.29	7.19	.59	76.61
44450	...do.....	11.14	1.06	1.60	7.44	.57	78.19
44452	...do.....	11.83	1.45	2.04	8.88	.63	75.17
45562	Medium.....	12.06	1.37	1.85	9.75	.96	74.01
44454	Dark.....	11.67	1.21	1.82	8.94	1.04	75.32
45539	...do.....	9.68	1.72	2.80	11.94	1.04	72.82
45545	...do.....	10.98	1.65	2.77	21.00	1.01	62.59
44449	Very dark.....	13.94	2.21	3.33	15.94	1.21	63.37
44455	...do.....	12.17	1.44	2.43	11.13	1.29	71.54

¹ The results in this table illustrate the variation in the composition of light and dark buckwheat flour. As the percentage of protein and fiber increases the flour becomes darker.

TABLE 8.—*Analyses of buckwheat hulls*¹

Sam- ple No.	Variety	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
45541	Japanese buckwheat hulls.....	6.36	2.01	0.76	2.89	49.43	38.55
45542b	Silverhull buckwheat hulls.....	6.41	1.78	.53	3.06	52.09	36.13
45851b	Tartary buckwheat hulls.....	7.85	1.33	.31	1.93	54.95	33.63
45555	Mixed buckwheat hulls.....	8.58	2.18	.30	3.76	49.97	35.21
45561	do.....	7.51	1.87	.44	3.50	48.16	38.52
44445	do.....	9.07	3.04	2.43	9.81	39.89	35.76
44453	Buckwheat bran (hulls).....	9.77	2.15	.86	4.11	45.97	37.14

¹ The hulls of the first 3 samples were entirely freed from endosperm; the other samples were analyzed as originally taken at the mill. Analysis of No. 44445 indicates the presence of excessive endosperm.

TABLE 9.—*Analyses of various buckwheat by-products*¹

Sam- ple No.	Trade name	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract	Hulls	True mid- dlings
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
45540	Buckwheat feed.....	7.38	2.65	2.85	11.94	36.53	38.65	55.6	41.4
45556	Buckwheat middlings.....	10.11	4.52	6.54	26.00	16.50	36.33	18.3	81.7
45557	do.....	10.03	4.62	6.88	26.63	10.95	40.89	10.4	89.6
45559	do.....	10.73	5.18	8.55	33.19	6.60	35.75	6.4	93.6
45560	do.....	11.55	4.06	6.59	26.88	9.95	40.97	7.4	92.6
45547	Buckwheat feed.....	8.68	5.16	4.89	21.31	19.77	40.19	-----	-----
44451	Buckwheat middlings or shorts.....	11.28	4.62	6.54	23.13	13.10	41.33	-----	-----
44458	Buckwheat feed.....	9.46	3.34	4.53	17.31	19.32	46.04	-----	-----
44457	Buckwheat feed from roasted and kiln-dried buckwheat products.....	9.56	3.24	4.87	17.69	19.93	44.71	-----	-----

¹ Included in this table are the percentages of hulls and true middlings in each of the first 5 samples. These show plainly why the commercial type of middlings varies so decidedly in feeding value.

TABLE 10.—*Analyses of miscellaneous samples of buckwheat products*

Sam- ple No.	Product	Water	Ash	Fat	Pro- tein	Fiber	Nitro- gen-free extract
		<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
44462	Roasted buckwheat groats.....	10.14	1.22	2.43	8.50	0.65	77.06
44447	Buckwheat scourings.....	10.63	2.92	4.41	17.81	4.35	59.88
44460	do.....	10.79	6.94	1.87	8.50	10.16	61.74
44461	Buckwheat farina.....	11.97	.45	.38	3.66	.36	83.18
44456	Buckwheat screenings.....	10.09	4.34	3.62	12.44	11.03	58.48
	Green fodder ¹	63.40	3.60	.90	4.60	8.00	19.50
	Straw ¹	9.90	5.50	1.30	5.20	43.00	35.10

¹ HENRY, W. A., and MORRISON, F. B. (3, Table 1).

TABLE 11.—*Composition of ash of buckwheat*¹

Source	K ₂ O	Na ₂ O	CaO	MgO	Fe ₂ O ₃	P ₂ O ₃	SO ₃	Cl	SiO ₂
	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>	<i>Per cent</i>
United States.....	35.15	2.26	6.62	20.55	1.68	24.09	3.59	0.67	5.54
Mean of Wolf's analyses.....	23.07	6.12	4.42	12.42	1.74	48.67	2.11	1.30	.23

¹ Bureau of Chemistry Bulletin 13 (10, p. 1212).

SUMMARY

The United States produces annually between 11,000,000 and 15,000,000 bushels of buckwheat. Most of the grain is made into flour, which varies according to the locality in which it is to be consumed. Buckwheat flour is used mainly for making griddle cakes. It is also compounded with flours of other grains to make a prepared pancake flour mixture.

A comparatively small quantity of buckwheat is milled into groats, from which two types of foods are made, roasted broken kernels and farina. These are used in soups, as porridge, and occasionally as breakfast foods.

Of the buckwheat by-products, middlings have the greatest feed value. When fed with other suitable proteins to dairy cattle and swine they have given very satisfactory results. The hulls are worthless as feed, but they may be used for fuel, as bedding for farm animals, and for packing purposes.

Tables are included giving the analyses of the buckwheat grain and of its various milling products.

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